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BRITANNIA BEACH SOUTH

SITE DEVELOPMENT MASTER PLAN

VOL. 1 OF 5 - SUMMARY

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Britannia Beach South
Site Development Master Plan
Vol. 1 of 5 - Summary

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Study Limitations:

Table of Contents

BACKGROUND

This document is a site development master plan for a new community referred to as Britannia Beach South, located in the Squamish Lillooet Regional District (SLRD) beside Howe Sound and flanking Highway 99 (the Sea-to-Sky highway). The owner and proponent of the development concept is Tiger Bay Development Corporation.

The Master Plan consists of the following five documents:

Volume 1 of 5: Summary (this document) – This volume extracts the summaries and phasing plan from the Details volume. The reader should reference the Drawings volume when reading this summary.

Volume 2 of 5: Master Servicing Plan – This volume extracts only the phasing plan from Volume 3 together with the drawings *Site Plan – Interim* and *Site Plan-Final* .

Volume 3 of 5: Engineering – This volume contains the full text of the master plan together wilth many figures that will aid the reader's understanding. The reader intrepid enough to wade into this volume should also refer to the Drawings and Reference volumes.

Volume 4 of 5: Drawings – This volume includes full-sized drawings.

Volume 5 of 5: Reference – This volume contains consultant reference reports.

Site investigations undertaken for this plan include the "usual suspects": geotechnical, stream flood hazard, soil contamination, environmental, water table level monitoring, well drilling and aquifer testing. The specialist team for these investigations includes the following disciplines: geotechnical, hydrogeological, stream hydrology and hydraulics, transportation, traffic, wastewater treatment, environmental, contaminated site assessment, all coordinated and integrated by civil engineering. The master plan is conceptual; therefore, it purposely omits reporting on many details, that were actually developed to confirm feasibility, to focus on the bigger picture.

The term "site development" in this report is used to describe not only the conventional utilities such as water and sewer but also grading, erosion protection, flood protection, environmental protection and mitigation and similar topics.

OBJECTIVE

The objective of this master plan is to advance the investigations and planning to a sufficient level of detail to either completely confirm that an element is feasible (e.g. water supply and distribution) or that it is highly likely that a component can be resolved (e.g. debris flow).

The reader might wonder why the development team did not fully resolve all of the issues. The reasons are twofold:

- Some agencies wish to defer review or comment on a development proposal until the local government has ratified the development proposal. This leads to a classic "chicken and egg" dilemma. For example, the provincial environment ministry will only review the mitigation plan for riparian areas at an advanced design stage because they do not have the resources to

comment on preliminary planning proposals. Other agencies include MoTI, CN Rail, Fisheries, Ministry of Health and others.

- The proponent wishes to receive an indication that the development proposal enjoys the conditional support of the SLRD before committing to additional expensive and lengthy technical studies. In other words, are non-technical issues (political, social, administrative, etc.) standing in the way of approval? For this reason, the proponent is seeking First Reading as an indication of conditional support for the project before completing the technical tasks.

DEVELOPMENT FRAMEWORK

The site is approximately 55 kilometres (34 miles) north of the city of Vancouver, 33 kilometres (21 miles) north of Horseshoe Bay, and 12 kilometres from Porteau Cove. The development area is immediately south of Britannia Beach (Britannia Beach North), a community of approximately 300 residents and associated historical mining facilities, including the Britannia Mining Museum. The area is unorganized (not within a municipality) and under the jurisdiction of the SLRD. The Ministry of Transportation and Infrastructure (MoTI) is the approving authority.

The site occupies an abandoned gravel pit that has an extensive gently sloping area at low elevations flanked by steep slopes left behind by the mining operation. The soils under the proposed development areas consist of alluvial fan and outwash sediments that provide a suitable foundation for the proposed structures and utilities, are not susceptible to liquefaction during an earthquake and are not vulnerable to frost heaving. The lowest portion of the flat area is within the sea flood boundary and will require minor filling or raising of structures. The steep slopes are geotechnically stable, but some areas should be regraded and revegetated to provide a more erosion-resistant slope. The flat portion of the site has a high seasonal water table, which will limit the practical construction depth of structures.

Four streams with associated riparian borders traverse the site. The streams, the steep upland slopes to the east and the highway and railway are the main “form-makers” of the site. These features delineate development parcels that will be either used by the owner or sold to other developers to use in a manner consistent with the master development agreement.

Most of the development site lies entirely within previously disturbed land that has low environmental value. The margins of Gravel, Thistle and Daisy Creeks have regenerated a poor quality riparian boundary. The smallest stream, Minaty Creek, is intact, but its small size limits its environmental value. The three larger streams also present a debris flow hazard that requires mitigation. All streams are ephemeral and are dry during summer.

The lowest portion of the northern gravel pit is below the seasonal high water table. It has subsequently formed ephemeral pools and wetlands that are protected by the Riparian Area Regulation (RAR). A large area of this pool and wetland area is proposed to be used for development, and the lost area will be compensated by the construction of a higher quality pool and wetland complex. All riparian areas have also been widened beyond the minimum. The proposed riparian area is 102% of the existing riparian area.

The northern portion of the proposed development includes a large artificial surf pool (Wavegarden) with associated operations and guest facilities, including a 50-unit “surf hotel” and a separate brew-pub restaurant. The Wavegarden accommodates a maximum of 100 surfers at a time and a limited number of guests using the Wavegarden’s “beach” areas. Because of the limited number of concurrent users, the

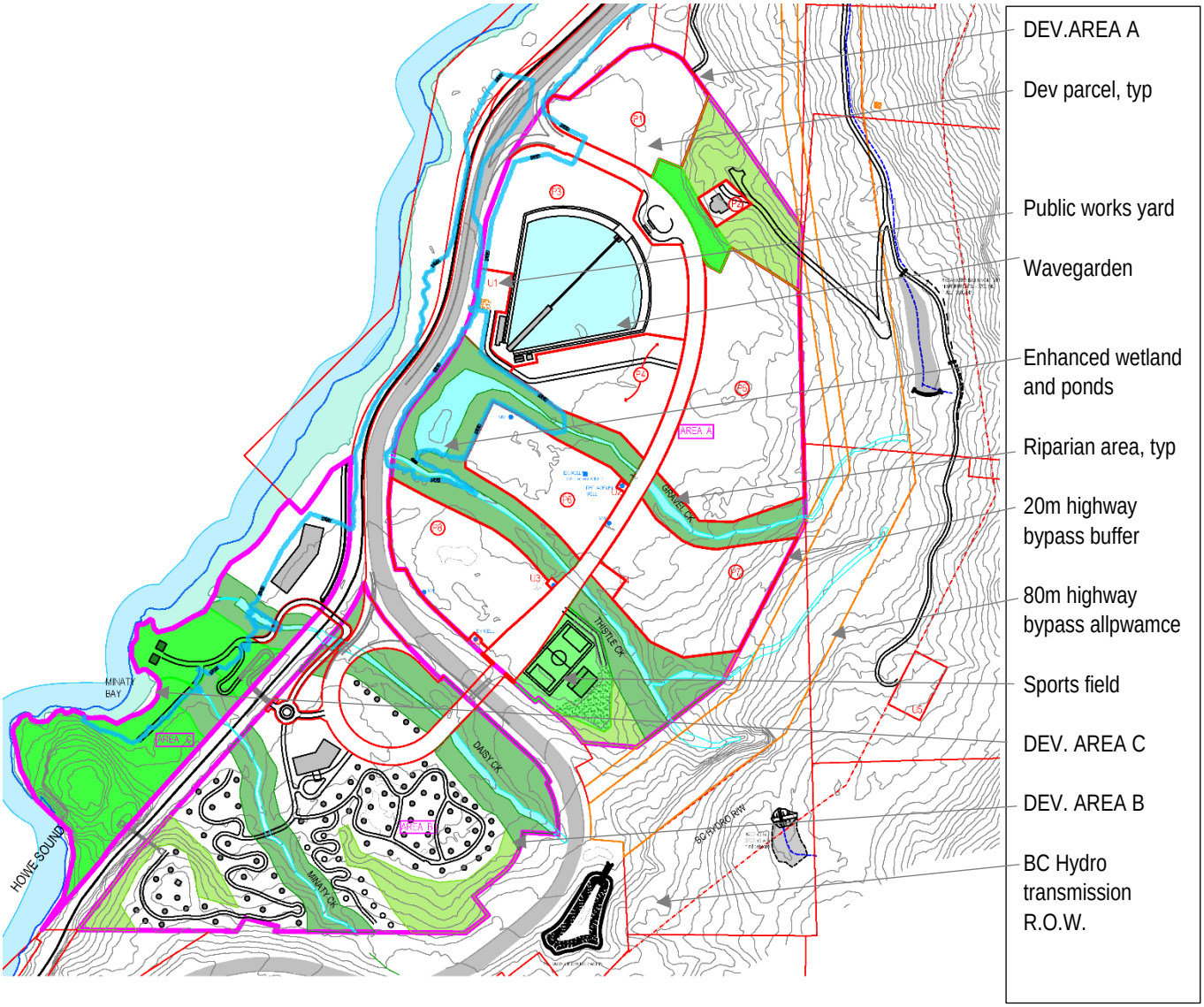
facility does not generate significant traffic loading. A mountain bike pump track is located between the Wavegarden and Highway 99. This provides an alternative semi-commercial attraction.

The remaining portions of the northern development area will be occupied by 1050 units of townhouses and apartments, the maximum amount permitted by the SLRD's Official Community Plan. The developer intends to maximize the number of townhouses with the balance of units being apartments. The residential area will include a small amount of local commercial and will include the usual parks, trails, paths, sports field & field house and other amenities. Some trails and paths will be routed through the riparian areas to provide "nature routes" where the disturbed area is compensated by additional riparian width. Other paths will be routed through the development parcels to offer more direct pedestrian routes through neighbourhoods. These cross paths will be a requirement of the development agreements for each parcel.

The portion of the site located south of the Highway 99 "S-bends" will be retained by the owner and used for tourist accommodation consisting of a 30-unit waterfront lodge, 30-unit resort, and 80-units of cabins and "glamping" sites sprinkled over the hillside. The waterfront lodge is separated from the resort / cabin site by the CN Railway. The majority of the waterfront site will be dedicated as a rustic and undeveloped regional park owned and operated by the SLRD.

Figure 1 illustrates the site, and the three Development Areas A, B and C. Area A contains the Wavegarden, park, sports field and eight development parcels. The remaining areas include the tourist facilities.

Figure 1: Development framework



DEVELOPMENT PLAN

Some development sites are happily blessed with benign topography, easy access, docile streams, cooperatively located riparian areas and a municipality on its borders that is eager to extend utilities to service the site. This is not one of those lucky sites. Some of the riparian areas are ill-placed. The streams have a significant though manageable debris flow hazard. Some of the topography is over-steepened by the gravel operation. There is no willing municipality to extend services because there are no municipalities nor services. Therefore, the proponent must create the entire site development solution.

This leads us to the next part of this discussion, which is a summary of the development plan. The reader can consult the summary at the end of each chapter of Volume 3 for more details, or the body of each chapter of Volume 3 for the most complete discussion of each topic. Volume 4 includes the supporting studies.

Environmental Setting

The site contains a single biogeoclimatic subzone: Coastal Western Hemlock Dry Maritime subzone (CWHdm). This subzone is characterized by warm, relatively dry summers and moist, mild winters with little snowfall. The environmental assessment indicates that the site has mainly been influenced by gravel extraction, logging and electrical transmission lines

Wildlife and wildlife signs were observed and habitats could potentially exist on the site, based on habitat conditions. Ten bird, four mammal, three amphibian and three invertebrate species are identified by the BC Conservation endangered listed species that occur in the CWHdm biogeoclimatic zone within the SLRD. Two blue-listed species are confirmed to occur on the Britannia South site and four blue-listed species possibly occur on the site. Red-listed species are unlikely to be found on site.

The proposed development site includes four streams and a wetland area.

The **natural wetland** area will be highly disturbed and compensated by construction of a higher quality deep pool and wetland area.

Gravel Ck currently flows along an unstable alignment down the steep slopes of the gravel pit, through barren gravel pit with no natural riparian border, through the poor quality natural wetland and discharges to Thistle Ck near the highway culvert outlet. Gravel Ck will be provided with a stable armoured alignment down the steep slope and an enhanced riparian border.

Thistle Ck occupies a stable alignment to the gravel pit floor and then follows a stable alignment to its outlet through the highway culvert. The creek was highly disturbed by the gravel pit operations but has reestablished a natural though poor quality riparian vegetated border. Thistle Ck will remain undisturbed and the riparian border will be widened and enhanced by appropriate plantings.

Daisy Ck will require armouring along its upper reach downstream of the highway culvert crossing. The disturbed areas will be reinstated and the riparian border will be expanded and enhanced. The creek downstream of this disturbed area will remain untouched and will be provided with a widened riparian border.

Minaty Ck will remain undisturbed and will be provided with an extended riparian border.

Geotechnical

The Geological Survey of British Columbia describes the surficial geology of the area as alluvial fan sediments consisting of poorly sorted sand and gravel forming the base of the mountain slopes. These sediments overly glaciomarine terrace sediments comprising stratified massive sand and gravel deposits and stratified proglacial deltaic sediments consisting dominantly of sand and gravel with minor silt and clay, locally up to 10m thick over glaciomarine silt and clay.

Site-specific geotechnical investigations confirmed the general classification for the site and concluded that the site was suitable for the intended purpose. Native soils consist of the original gravels and sands, fill consisting of reworked gravels and sands and other materials, and overburden materials remaining from the gravel mining operations.

Although there is no danger of slope instability, it is nevertheless recommended that slopes steeper than 2H:1V be regraded and vegetated to reduce erosion and ravelling and also to reduce fall hazard.

Technical observations include the following:

1. The corrosion potential, soluble sulphate concentration, liquefaction potential (seismic) and expansion potential of the soils are low.
2. Replace the overlying disturbed soil with well compacted engineered fill (maximum 300 mm loose lifts, within 2% of optimum moisture content and compacted to 95% of ASTMD1557 “Modified Proctor” density) to limit differential settlement. Most of the native material might be useable as engineered fill. Site stripping and replacement should extend a minimum of 1.5m or equal to the depth of excavation beyond the footing, whichever is greater.
3. The peak ground acceleration at this location is 0.29g for the 1:2475 design ground motion event. This corresponds to a probability of occurance of 2% in every 50 years.
4. Temporary excavations should have a slope no steeper than 1.5H:1V.
5. Dewater excavations during construction to depress the water table surface at least 0.6m below the underside of the foundation.
6. Conventional spread footings can be used for structures at serviceability limit state bearing pressure of up to 125 kPa and factored ultimate limit state of 250kPa supported on native soils or engineered fill.
7. Frost protection depth is 0.45 m.
8. Earth pressures for foundation or retaining wall design are: static Pa = 5.4*H (where Pa is lateral earth pressure in kPa due to static loading and H is wall height in m) and seismic Pe=2.7*H (where Pe is earth induced earth pressure in kPa using inverted triangular distribution and H is wall height in m).
9. The Wavegarden design should incorporate an underslab drainage layer, using dewatering pumps to depress the groundwater level 0.6m below the underside of the pool floor when the pool is empty of water.

Contamination

Environmental matters pertaining to contaminated sites in British Columbia fall under the jurisdiction of the Ministry of Environment (MOE), under the *Environmental Management Act* (EMA). The primary regulation under the EMA relating to the assessment and remediation of contaminated sites is the Contaminated Sites Regulation (CSR). The CSR sets out legal procedures for screening sites, determining if a site is contaminated, assessing liability, initiating remediation processes, and setting standards for site remediation and soil relocation. The site screening proceeds through two stages.

The Stage 1 study involves a review of historical maps and aerial photographs, land title records, government databases, previous consultant reports, on-site interviews and site inspections to identify Areas of Potential Environmental Concern (APECs). The Stage 1 study does NOT include any sampling.

The Stage 2 study includes investigation of soil and groundwater conditions within the APECs to determine if contamination is present.

Site investigations and soil analysis results indicate concentrations of potential contaminants of concern are below soil standards appropriate for the anticipated future use. Based on these analytic results, it is concluded that the site is uncontaminated for its intended use with respect to soil.

Coastal Flood Hazard

Coastal flooding can encroach on the development lands by a combination of high tide, higher sea levels due to climate change, wind surge and wave runup on the beach fronting the site. Highway 99 is slightly raised in the reach fronting the development and will protect the site from wave runup. In practice, the joint probability of a high tide occurring at the same time as a major surge and wave runup event is small and would also only occur for a few hours during high tide. This adds a large degree of conservatism to the recommended sea flood protection elevations. Also, wave runup will have a greatly reduced effect on land set-back from the shore. The following are recommended minimum elevations with respect to the sea level flood:

Component	Criteria	Minimum elevation
AREA A		
Structures	high tide + sea level rise + storm surge + freeboard	(4.95 m say) 5.0 m
Roads & lands	high tide + sea level rise + storm surge	(4.35 m say) 4.4 m
AREA C		
Structures	high tide + sea level rise + storm surge + wave runup +freeboard	5.6 m
Roads and lands	high tide + sea level rise + storm surge + wave runup	5.0 m

The owner wishes to avoid using land for a dyke. Therefore, a combination of land raising and building raising will be used for protection from sea flood.

Site Grading

Grading is influenced by the sea flood level, potential stream floods, debris flows, steep slopes on the eastern perimeter of the site that require stabilization against erosion and drainage. The sea flood affects only a small portion of the site and is easily mitigated by slight filling and building raising. Potential stream floods are mitigated by low berms built where required along the outside perimeter of the riparian borders. Land-filling for sea flood will also mitigate stream flood in the lowest areas. The steep slopes, though geotechnically stable, will be regraded and revegetated to be more erosion resistant. The remaining site grading will introduce gentle gradients to the development parcels to facilitate site drainage and also borrow fill material where possible.

Stream Erosion Protection

Minty Creek is the smallest stream and requires no intervention. Gravel Ck is highly disturbed by the gravel extraction operation and it will be rerouted along a stable alignment with armoured stream bed down the steep eastern slope and training berms where required to control avulsion and contain flood potential. Thistle Ck is well entrenched along most of its length through the development area and requires little intervention. A few training berms are required along an upstream reach east of the site to avoid stream avulsion. Daisy Ck is the largest stream and requires stream bed erosion protection downstream of its Highway 99 culvert crossing, a training berm along one bank below the highway and training berms in along an upstream reach to block potential avulsion. These hazards can be mitigated by low-risk conventional techniques.

Stream Debris Flow Hazard

Gravel, Thistle and Daisy Cks have debris flow potential identified by preliminary studies completed by Thurber Engineering.

The debris flow hazard for Gravel Creek and Thistle Creek is mitigated by construction of small debris catchment basins on each creek and by the use of armoured deflection berms in areas of potential channel avulsion. The debris basins are located immediately upstream of the steep slope leading to the development site.

Debris flow hazard for Daisy Creek is mitigated by the existing debris basin installed by the Ministry of Transportation and Infrastructure in 2008 for the 2010 Olympics highway upgrading project. This basin is sized to contain the debris volume generated by the 1:2,500 year return period event. Clear-water overflows, or debris volumes in excess of the 1:2,500 year event, will be deflected away from the development using a deflection berm that retains the overflow within the highway right of way. In the unlikely event that an overflow is not retained within the highway, the plan locates a sports field and associated lower risk facilities in the potential overflow area that will act as a secondary debris basin retained by the road embankment leading to the highway underpass tunnel.

Tiger Bay has initiated more detailed hazard and risk assessments of these creeks by a specialist consultant, BGC Engineering Inc., who will provide detailed recommendations for mitigation. In the meantime, the proposed solutions suggest that debris flow risk is mitigatable at a manageable cost.

Transportation Analysis

The traffic loading was analyzed by a traffic consultant to understand the potential impacts to traffic flow along Highway 99. The proposed access strategy was evaluated based on a phased approach to meet access requirements at each development phase and impacts along the highway

The traffic analysis evaluation scenarios included the typical winter Friday AM, Friday PM and Sunday afternoon peak hours, which represent the peak hour traffic volume conditions along the Sea to Sky corridor.

Immediate upgrading of Hwy 99 is required, between the Britannia Ck bridge and the existing North Access, to provide an acceptable level of service for current and background traffic growth (not including this development) during the peak traffic periods.

The North Access to the site will be upgraded in Phase 1 for improved full turning access and then converted in Phase 2 for right-in and right-out only access. The South Access will be built in Phase 2 for right-in and right-out access.

The traffic analysis is under review by MoTI and further discussions will define any additional response required by Tiger Bay.

Roads

The development plan includes the construction of one main collector road referred to as Britannia Boulevard. This road uses a 22 m wide right of way with 40 km/hr speed limit for improved safety and comfort for residents. The detailed design of the road should incorporate frictional elements (landscaping, narrower lanes, bump-outs, raised pedestrian crossings, etc.) to naturally attenuate traffic speeds.

Britannia Boulevard incorporates treed boulevards on both sides, parking alternating with rain gardens on both sides, bicycle sharrows on both sides and a 3m wide multi-use path (MUP) on the east side intended for pedestrians, slow cyclists and wheelers. The intention of the slower speed limit and MUP is to encourage active transportation by providing enhanced safety and comfort.

Britannia Boulevard extends from the North Highway Access to the South Highway Access and provides, together with the streams and highway, the definition of development parcels.

Local roads within development parcels will be the responsibility of the developers of those parcels.

Paths and Trails

A network of surfaced paths extend beside the streams and across the development parcels to provide recreational opportunities, enhance active transportation and provide alternative links between neighbourhoods. The paths routed within the riparian areas are mitigated by extending the width of the riparian borders supported by an assertion that humans should also benefit from low impact use of the environmental reserves.

Smaller earthen trails are included to access points of interest such as the top of the rock bluff and the area above the development.

Highway Underpass

An existing single-lane highway underpass culvert connects Area A with Areas B&C and provides a travel route to the South Access. The underpass consists of a large corrugated metal pipe that was built in the 1950s during the original highway construction. The steel culvert pipe is corroded and might be near the end of its life. Tiger Bay will be approaching MoTI to replace or repair the culvert (perhaps with concrete slip lining) so that it is structurally suitable to support the highway for the long term and so that it satisfies MoTI's responsibility to provide access to lands otherwise cut off by the highway.

The underpass will be further upgraded in Phase 2 to provide a single-lane alternating signalized vehicle passage with narrow raised pedestrian sidewalks both sides. The tunnel and entrance will be upgraded with enhanced lighting and the entrances will be landscaped to improve the aesthetics and comfort, especially for pedestrians.

MoTI standards require two-lane access to all lands as a condition of subdivision approval. Transportation studies by Bunt have demonstrated that signalized single-lane access is sufficient for the anticipated traffic. Further discussions will reveal if the expensive and disruptive construction of the two-lane underpass can be avoided.

CN Rail Crossing

Areas B and C of the proposed development abut the CN Rail line, which is a "Principal Branch Line" hosting a maximum of 5 trains per day at a speed of 25 mph. The southern portion of the rail alignment is set many meters below the surrounding land in an excavated trench. The final 300 m of rail through the north end of the neighbourhood, is at the same grade or higher than the surrounding land.

The existing private crossing is located on the north side of Daisy Creek, where the railway crosses the creek. It is an informal access that served the miners community for decades, and it must be substantially upgraded to conform to current requirements for a private crossing. A private crossing can be used only

by the landowner and its employees. Further upgrading is required to convert the private to a public crossing, and approval for this change is not assured.

Construction of the South Access during Phase 2 will block the existing informal access road to the private railway crossing. There are two options for a permanent rail crossing:

- an at-grade railway crossing located about 20m north of the existing crossing, and/or
- an elevated crossing located 130m south of the existing private crossing where the railway is entrenched, and a bridge can launch off the high vertical rock banks on both sides.

The at-grade option can be used for a public crossing if the proposed non-conforming approach road geometry is approved my MoTI. If this is not approved, then the at-grade crossing can only be used as a private crossing.

The elevated crossing option is suitable for public pedestrian/cart access because it uses a compact ramp structure on the west side drop from the bridge elevation to the shore elevation. The elevated crossing is unlikely to be suitable for a public vehicle crossing because of the large west side ramp required. Therefore, only a public pedestrian/cart bridge is recommended.

The preferred rail crossing option and configuration will be determined through future discussions between CN Rail, SLRD, Tiger Bay and MoTI.

Highway Bypass

The development plan allocates an 80m wide reserve for a future highway bypass located on the hillside above the new community and located immediately adjacent to the BC Hydro right-of-way and in an area that was originally planned to contain over 100 single-family lots. The proposed development areas are separated from the bypass corridor by an additional 20m wide buffer. The bypass will provide for higher speed movement of through traffic along the Sea to Sky Corridor.

After construction of the bypass, the old highway route through the lower lands at Britannia Beach would become an urban collector route for the community with slower-moving vehicle traffic mixed with pedestrians and cyclists with an urban streetscape.

The timing for this expensive construction is uncertain, and MoTI indicated it might be in the order of 15 to 30 years or beyond and is not being actively pursued. Access intersection improvements will be simplified if the bypass is implemented while the project is under development.

Water Servicing

Domestic and Wavegarden water supply will be provided by three or four wells developed in the local aquifer that is recharged by infiltration from Gravel and Thistle Creeks and by runoff from the adjacent slopes. Based on the results of an extended aquifer pumping test conducted between July and October 2013, Piteau (2014) concluded that the existing test wells TW1 and TW2 can sustain individual flows of 26.7 and 19.9 L/s respectively over the dry period. The combined flow of the test wells is about 46.6 L/s (rounded to 47 L/s). This flow can be pumped from the aquifer over a 100-day drought period, without causing saltwater intrusion from Howe Sound. Groundwater flow simulations (rather than testing) revealed that a maximum combined sustainable aquifer yield of 56L/s to 72L/s might be feasible, assuming the use of the Test Wells plus two additional Proposed Wells, during a 100-day drought period.

The total aquifer withdrawal should be limited to 75L/s to avoid triggering an expensive and lengthy environmental assessment process, which is a provincial requirement if this amount is exceeded. This limitation suggests that the maximum pumping capacity of each well should be 75 L/s divided by the number of wells or:

- Two wells: 37.5 L/s
- Three wells: 25.0 L/s
- Four wells: 18.8 L/s

The groundwater is of the calcium-carbonate type, slightly acidic and very low in dissolved minerals and metals. Concentrations of all chemical parameters tested were less than the Guidelines for Canadian Drinking Water Quality (GCDWQ) and there were no detectable concentrations of hydrocarbons or herbicides associated with potential sources of contamination.

The water table was measured to rise to within 1m of the ground elevation in one of the monitoring wells. The aquifer soils consist of gravels and sands from the base of the aquifer to the ground surface therefore the aquifer is unconfined, meaning that surface water or contaminants can migrate through the soil to the aquifer. Groundwater at risk of containing pathogens (GARP) is defined as a groundwater supply that is likely to be contaminated by any source of pathogens (anthropogenic or natural), or disease-causing organisms. Therefore the aquifer is likely to be considered GARP and as such requires treatment by two-stage disinfection and filtration unless it can be demonstrated that filtration is not required. Given that the seasonal high water table is within a meter of the ground surface, it is highly unlikely that filtration will be exempt therefore treatment will consist of pH adjustment, filtration, UV disinfection and chlorination to provide a disinfection residual.

The water infrastructure will consist of the wells pumping through a raw water (untreated) main to a water treatment plant and toi the Wavegarden for pool filling. Treated water will be pumped from the water treatment plant to two elevated reservoirs on the hill east of the BC Hydro right of way. Two reservoirs are provided for redundancy during servicing. Water is distributed to the system using a large diameter pipe extending from the reservoir to a pipe that extends from the North Access to the South Access. The pipes and reservoir are sized for a fire flow of 150 L/s. Each development parcel will be serviced from this spine water main.

Wastewater Servicing

The existing North Britannia community is serviced by a gravity collection system and sewage pump stations discharging to a Waste Water Treatment Plant (WWTP) located on the north side of Britannia Creek and on the east side of Hwy 99. The treated effluent discharges through a marine outfall into Howe Sound.

The WWTP was designed to accept the flow from both N and S Britannia. The WWTP was built to treat the flow only from N Britannia. Tiger Bay will therefore be responsible for increasing the treatment capacity of the WWTP to handle the flows from South Britannia.

The sewage collection system will consist of:

- conventional gravity sewers serving Area A, and
- a low-pressure sewage pumping system serving the lodge, resort, cabins and glamping sites in Areas B and C.

The gravity collection system will discharge to one sewage pumping station (referred to as a lift station) located next in the Public Works Yard between the highway and the Wavegarden.

All resort facilities in Areas B and C will be served by grinder pumps that discharge into a common pressurized sewage force main. This system will provide flexibility in locating facilities and routing sewer pipes. In addition, the high-density polyethylene piping will provide flexibility in the event of soil settlement. The force main will discharge into the first gravity sewer manhole north of the highway underpass and will flow by gravity to the main sewage lift station. The lift station will pump the entire sewage flow from the development through a force main to the existing wastewater treatment plant.

Most of the development parcels in Area A will discharge by gravity into the gravity sewer in Britannia Blvd. The exceptions are development parcels P6 and P8, which are lower than the gravity sewers and will be required to pump their flows into the main gravity sewer. In all cases, the developers of each parcel will be responsible for the design and construction of the sewers that service their parcels, and the strata corporations of each parcel will be responsible for operation and maintenance.

Stormwater

Drainage patterns are dominated by steep slopes to the east and the four creeks and associated low land wetland areas.The site experiences generally dry summers and wet winters. Large runoff events can be generated by winter storms, and peak runoff is often generated by heavy rain associated with warm Pacific fronts falling on and melting snowpack in the mountains. These peak events can generate debris flows in susceptible creeks.

There are eight development parcels delineated on the drawings, plus the sportsfield parcel and Areas B and C. Each parcel is accessible to one or more drainage discharges (streams or ocean) and each parcel will be required to independently manage its own storm water discharges in compliance with the detailed requirements outlined in the Master Plan document.

Electrical Power

BC Hydro is responsible for the power system planning, design and installation, with the construction of associated civil works remaining as the responsibility of the Developer. The electrical load for system design is estimated on the basis of building types and projected energy uses and this will be completed during the next stage of design. The Wavegarden has a substantial power demand that must be accommodated by the system.

BC Hydro transmission lines run along the eastern boundary of the development area. North Britannia is serviced from a sub-station above the mine building on the north boundary of the development area. The sub-station will require upgrading and costs and details are subject to negotiation with BC Hydro.

The electrical distribution system will be constructed underground in the boulevard behind the curb line or in the road shoulder in the public road right-of-way. Major structures such as pull boxes, transformers and switching kiosks will be located in boulevards with protection provided from snow removal equipment.

Natural Gas

Natural gas system design and installation is the responsibility of FortisBC. There is currently no natural gas supply near the site and preliminary discussions indicated that the system could be extended to

Britannia but at substantial cost to the developer due to the long time required to sell the properties and therefore recoup the infrastructure investment. Further discussions will be carried out to determine if the cost can be absorbed by the project. The fall-back position is to use electricity for heating combined with high-efficiency building envelopes and appliances to reduce energy use and cost to the building owners, and load on the grid.

Communications

Bell Canada is the telecommunications service provider for the Britannia community. The developer will be responsible for installation of the civil works (ducts, vaults, boxes) in the streets and into buildings, normally in common trench with the underground electrical distribution system. The utility company will install the wire/fibre.

The Cablevision provider is responsible for system planning and design and is normally responsible for all installation costs, including underground civil works.

Public Safety

The community will require the usual public safety facilities that will be integrated with those presently serving North Britannia. Specifically, the Britannia Beach Volunteer Fire Department must be expanded to provide fire protection and first responder services. This might also include an ambulance service. Tiger Bay anticipates a requirement to make a contribution to the upgrading of the existing public safety services to expand their capacity.

MASTER SERVICING PLAN

Construction of the development will be phased over many years to suit market conditions and infrastructure sequencing.

Phase 1 (present - 2025)

Phase 1 development (also referred to as the Interim development) is illustrated on will include the Wavegarden, recreation area (pump track, skate park, etc.), brewpub and up to 20 cabins and glamping sites temporarily located beside the Wavegarden configured as a surfing village. The cabins/glamps will be relocated to Area B in a future phase.

Access to the site will be provided by the existing North Access only. Phase 1 will operate with interim servicing to allow deferral of many servicing elements. The utilities will be built to a long term but not municipal standard with the understanding that the interim facilities will be replaced by the permanent facilities in subsequent phases. The intention is to allow the site to be occupied for an indeterminate time without the need to initially build the expensive full build-out services.

All roads and utilities in Phase 1 will be private and will be built and operated by Tiger Bay. Servicing elements that will be incorporated into the final servicing will be built to SLRD and MoTI standards with the details of inspections and approvals to be negotiated.

Phase 1 site development and utilities are illustrated on the drawing entitled *Site Plan, Interim* and will include the work described below.

Grading

- Raise the site sufficiently to allow permanent buildings to be constructed to a flood construction level of 5.0 m. The cabins will be portable and will not be flood-proofed as they can be vacated if a flood is imminent. Floods depths are very low and the only hazard is to property, not life.

Stream and debris hazard protection

- Regrade and stabilize the steep slopes surrounding the upland area of Gravel Ck.
- Realign Gravel Creek into its final configuration complete with training berms, channel hardening and bank erosion protection in the steep upland area.
- Construct the small debris basin and associated works on Daisy Ck.
- Confirm if a debris flow on Daisy Ck can affect the Interim Phase 1 development and how this can be mitigated. It is unlikely that the Wavegarden will be affected as it will be raised significantly to mitigate high water table. The brew pub will likewise be raised to conform to the generally raised site required to conform to the raised Wavegarden. The cabins, being temporary, are not intended to be raised but this might prove to be necessary. The need for debris flow mitigation will be confirmed by ongoing hazard studies.

Environmental mitigation

- The Wavegarden will occupy a substantial portion of the existing riparian areas associated with the Gravel Ck wetlands. Phase 1 will include construction of the new wetland and pond system, new riparian areas surrounding the realigned Gravel Ck, and retention of the existing riparian areas in Parcel P6 that are not used for development in this phase.
- The permanent riparian areas set aside in Phase 1 will be smaller than the area lost to development. We anticipate the need to negotiate a suitable agreement with the environmental agencies, that might be registered as a covenant on title, to provide assurance that the total agreed upon riparian compensation will ultimately be provided.
- Establish covenants over the permanent riparian areas related to Gravel Ck and the new wetland/pond.

Roads, parking and paths

- Construct minor improvements to the existing North Access including an improved northbound deceleration lane and ramp into the site and an improved northbound ramp with acceleration lane out of the site, while maintaining operation as a full movement stop-controlled intersection.
- Build a short section of Britannia Blvd. from the North Access to a temporary roundabout at the intersection of Britannia Blvd and the service road to the public works yard. This will provide access to the Wavepark, surface parking lot, brewpub, cabins and the farmer's market. Note that the farmer's market is a separate initiative that incorporates its own parking lot. This road will be a private two-lane road using seal coat surfacing with gravel shoulders and ditches.
- Gravel surfaced two lane 6m wide service road from Britannia Blvd. to the works yard and Wavegarden operations buildings. This road will also provide access to the 20 cabins.
- A gravel-surfaced guest parking lot with lighting and interim landscaping using native drought resistant plants.

- Upgraded private access road from the Ph.1 Britannia Blvd. through the culvert underpass, CN Rail surface crossing and to Minaty Bay. The service road will be used for operations and maintenance access to the property and for fire protection access in the event of a wildfire. The access road will continue to use the existing highway underpass and stream crossing bridges and culverts.
- Upgraded CN Rail private surface crossing to conform with permit requirements.
- Interim street lighting mounted on overhead utility poles and pedestrian lighting along formal pedestrian paths.

Water

The Phase 1 water system consists of the following components:

- Outfit both existing wells (TW1 & TW2) with 25 L/s pumps with VFD control, pumping through the raw water watermain installed in its permanent location to the Wavegarden operations centre and Public Works Yard that will contain a containerized interim water treatment plant. This water will be used untreated for filling the Wavegarden pool and treated for supplying potable water demands of the Wavegarden, brewpub, market and cabins. The pumps are controlled by the water level in the ground-level reservoir. Note that the well capacities will fluctuate seasonally so use well level sensors to control the VFD to limit the well pumping rate to avoid over-pumping the wells.
- Permanent raw water main from the wells to the interim water treatment plant that is located in the Works Yard. The raw water main will supply untreated water to the treatment plant and to the Wavegarden for pool filling. It will also supply 50 L/s fire flow from the wells through a cross-connection to the future domestic water distribution main noted below.
- Containerized water treatment plant in the Public Works Yard containing a 1-hour volume flow equalization tank, pH adjustment, filtration, UV disinfection and chlorination sized to provide Ph.1 potable water demands.
- Treated water main from the treatment plant to the ground level reservoir. The UV treatment allows direct discharge of the treated water into the reservoir without providing additional chlorine contact time.
- Bolted steel ground level water storage reservoir sized for two days of emergency supply, flow equalization and cabin fire sprinkler storage for the Phase 1 development.
- Containerized potable water booster station to pump domestic and cabin fire sprinkler demands through small diameter water mains from the reservoir to the Ph. 1 buildings.
- 100 mm (4”) high density polyethylene treated water distribution loop around the Wavegarden that will be used in the final configuration as an irrigation supply pipe.
- Build the future water distribution mains in Britannia Blvd and the service road complete with fire hydrants. Cross-connect these distribution mains to the raw water supply pipe from the wells to distribute raw water to the hydrants for fire protection.
- Fire hydrants on the large diameter water distribution main to supply fire trucks and fire mains to the fire sprinklers in the brewpub and Wavegarden buildings. The well pumps will supply the sprinkler flows. This strategy is subject to the approval of the fire commissioner and the insurance underwriters.

Sewer

- Permanent gravity sewers from the Wavegarden, brewpub, cabins and farmer's market to the permanent sewage lift station.
- Permanent sewage lift station with temporary smaller capacity sewer pumps and electrical controls and switchgear.
- Permanent sewage forcemain from the lift station to the Britannia wastewater treatment plant.
- Wastewater treatment plant upgrading necessary for the Phase 1 sewer flows.

Landscaping

- Permanent landscaping for the Wavegarden, recreation area, and brewpub.
- Temporary landscaping for the cabin village, roads and surface parking lot.

Power and communications

- Extend a permanent large capacity overhead electrical service from the BC Hydro transformer station above the Britannia mine building to the Wavegarden, brewpub and the service building for the cabins. This will require upgrading of the transformers at the transformer station.
- High speed wired and wireless internet and CCTV.

Drainage

- All drainage will use surface ditches and swales discharging into ground, constructed rain gardens or to the drainage detention pond associated with the Public Works Yard.

Phase 2 (2026-2030)

Phase 2 initiates construction of the permanent core utilities to service the initial phases of residential and commercial development in Parcels 1, 2, 4, 5 and 6 and the tourist accommodations in Area B. Phase 2 servicing will require most of the permanent "buildout" utilities and services that are illustrated on *Site Plan – Final.*

Developers of each of the development parcels will be responsible for planning, designing and building full servicing for each development parcel including private road or driveway entrance onto Britannia Blvd, metered utility connections for water and sewer, on site drainage, detention and overflow to the discharge location noted on Dwg. 2. The private services in Area B are not included in the following list.

The following elements of the buildout drawing are included in Phase 2.

Grading

- Regrade and stabilize the steep slopes in Parcel P5 and Area B.

Stream and debris hazard protection

- Daisy Creek training berms and debris basin improvements identified by subsequent study.
- Thistle Creek debris basin and channel training.

Environmental mitigation

- Complete Thistle Creek and Daisy Creek riparian area upgrading.

Roads, parking, paths

- North Access built to final configuration.
- South Access built to final configuration
- Upgraded highway underpass. The extent of upgrading or replacement will be determined through negotiations with MoTI and is currently uncertain. It will consist at least of structural upgrading of the existing underpass and configuration as a signalized single lane underpass.
- Britannia Boulevard connecting the North Access to the South Access built to final configuration complete with paving, boulevards, multi-use trail, pedestrian crossing, rain gardens, parking and lighting.
- Permanent stream crossings over Gravel, Thistle and Daisy Creeks.
- Restricted access service road from Britannia Blvd to the existing CN Rail surface crossing. It remains to be determined if this crossing will remain private or if it will be located in a statutory right of way for restricted public use to service the park and the future waterfront lodge.
- Minor upgrading of the BC Hydro access road to provide all weather access to the reservoir site.
- Public path through the Daisy Ck riparian area.
- Public path beside Thistle Ck located in the water main easement.

Water

- Decommission temporary water treatment, storage and pumping at the Public Works Yard.
- Drill one or two additional wells (contingent on yield) at locations PW#1 and PW#2 and outfit all wells with VFD controlled pumps. Reconfigure maximum pumping rates to match well capacity and so that total yield remains below the environmental review threshold of 75 L/s.
- Connect new wells to the Ph. 1 raw water main. Extend the raw water main to the water treatment plant.
- Construct one of two 50% capacity treatment trains at the new water treatment plant.
- Build the treated water supply main to the reservoirs.
- Build the final configuration of reservoirs. Both reservoirs are required for reliability, serviceability and for fire protection capacity.
- Water distribution main from the reservoir to the Britannia Blvd water distribution main.
- Water distribution main from the north side of the Highway 99 casing pipes connecting to the interim distribution mains in Britannia Blvd.
- Water main connection between N. and S. Britannia with pressure regulating station.

Sewer

- Decommission Phase 1 temporary sewer works.
- Extend force main and gravity sewers from the proposed Highway 99 sewer casing pipe along Britannia Blvd to connect to the interim sewer main in Britannia Blvd.

- Outfit the sewage lift station with full capacity pumps and controls.
- Upgrade the wastewater treatment plant to accept flows from Phase 2.

Power and communications

- Extend power and communication ducts and cabling through the length of Britannia Blvd. between the North and South Access.

Drainage

- Construct the permanent drainage facilities in Britannia Blvd including minor system piping, rain gardens, the works yard detention pond and the permanent major system flow paths.

Phase 3

Remaining infrastructure as required including:

- Second treatment train in the water treatment plant when required.
- Upgrading of the sewage treatment plant to service anticipated flows.
- CN Rail pedestrian overpass if required by subsequent negotiations.
- Upgraded existing service road to the cliff top park and restaurant.
- Remainder of paths and trails
- Regrade and stabilize the steep slopes in Parcel 8.
- Restricted access public service road through Area C (waterfront lodge) to the regional park.
- No additional works required.
- No additional works required.
- No additional power or communication works required.
- Additional drainage works required.

ISSUES

The following are the known significant issues that remain to be resolved:

1. Definition of the highway underpass between the north and south development areas. There is no question that the underpass is feasible as MoTI is required to provide access to lands beyond. At question is whether a single lane using the existing upgraded crossing will be approved, or if MoTI will insist on a new two-lane underpass. The Ministry has indicated that they do not wish to entertain this question until SLRD has indicated conditional support for the proposal. The issue is not feasibility, but cost to Tiger Bay.

2. Definition of the CN Rail crossing between Area B and Area C. The master plan outlines two potential crossings: an at-grade crossing that could be used for either a private or public crossing, and an elevated crossing that is only suitable for a pedestrian / cart crossing. Ownership and configuration of the crossing must be defined by the stakeholders: SLRD (owner of the park), Tiger Bay (proponent), MoTI (the road authority for a public crossing) and CN Rail.

3. Complete the hazard, risk and mitigation assessments of debris flow for Gravel, Thistle and Daisy Creeks. Preliminary studies by Thurber Engineering and potential responses proposed in this plan indicate that the hazard can be mitigated by relatively modest works. Further study will be undertaken by BGC Engineering to confirm the hazard, risk and mitigation requirements.

4. Consult MoTI to confirm if the sewer force main and water main connections between South Britannia and North Britannia can be located within the Highway 99 right of way. Conditional support for the development proposal by SLRD will allow the proponent to begin the review process with MoTI.

5. Consult the provincial environmental ministry and the federal fisheries ministry to confirm if the proposed riparian mitigation will be accepted. The proponent will be seeking an exemption from the usual review policy and will seek early consultation.